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Table of abbreviations

Full title	Abbreviation
95% confidence interval(s)	95% CI(s)
Activities of Daily Life	ADL
Angiotensin Converting Enzyme Inhibitors	ACE-Inhibitors
Angiotensin II type 1 receptor blockers	ARB's
Cardiovascular Disease	CVD
Chronic Heart Failure	CHF
Chronic Obstructive Pulmonary Disease	COPD
Chronic Respiratory Disease Questionnaire	CRQ
Cumulative Index to Nursing and Allied Health Literature	CINAHL
Endurance Shuttle Walk Test	ESWT
European Society of Cardiology	ESC
Forced vital capacity	FVC
Global Initiative for Chronic Obstructive	GOLD
Health Related Quality Of Life	HRQOL
Heart Failure	HF
High Frequency Coupling	HFC
Hospital Anxiety and Depression scale	HADS
Incremental Shuttle Walk Test	ISWT
Left Ventricular	LV
Left Ventricular Ejection Fraction	LVEF
Low Frequency Coupling	LFC

Table of abbreviations (Continued)

Full title	Abbreviation
Maximal Heart Rate	MHR
Maximal oxygen consumption	VO_2max
Metabolic Equivalents	METS
Meters	m
Millimetres	mm
Multidimensional Scale of Perceived Social Support	MSPSS
National Institute for Health and Care Excellence	NICE
Myocardial Infraction	MI
Scottish Intercollegiate Guidelines Network	SIGN
New York Heart Association	NYHA
Peak Oxygen Consumption	VO_2peak
Population, Intervention, Comparator, Outcome, Study, Design	PICOS
Post-bronchodilator forced expiratory volume in 1-second	FEV_1
Preferred Reporting Items for Systematic Reviews and meta-analysis	PRISMA
Quality of Life	QOL
Randomised control trial(s)	RCT(s)
Seconds'	s
Studies of left ventricular dysfunction	SOLVD
St. George's Respiratory Questionnaire	SGRQ

Table of abbreviations (Continued)

Full title	Abbreviation
Tai Chi Chuan	TCC
Tai Chi Chuan Qigong	TCQ
The medical subject headings	MESH
United States of America	USA
Word Health Organisation	WHO

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The Role of Tai Chi Chuan in Health Related Quality of Life in Chronic Obstructive Pulmonary Disease and Heart Failure: A Literature Review

(Adapted from Zazzle art, 2014)

Keywords: Cardiopulmonary diseases, Rehabilitation, Secondary prevention, Tai Chi

Words Count: 4,916

Literature review glossary

Asthma: is characterized by chronic inflammation leading in airflow obstruction and bronchial hyper responsiveness (Borish & Culp, 2008).

Bronchitis: its definition vary among epidemiologic studies; but the classic characterisation is chronic cough and sputum production for at least 3-months per year for two repeated years (Kim & Criner, 2013).

Emphysema: is a pathological term that is characterized by the loss of alveolar walls and loss of elastic recoil (Pauwels, Buist, Calverley, Jenkins, & Hurd, 2012).

Mucus hypersecretion: resulting in a chronic productive cough, is a feature of chronic bronchitis and is not certainly linked with airflow limitation (Pauwels et al., 2012).

Stages of COPD: stage I: mild COPD – is characterized by mild airflow limitation (FEV1/FVC < 0.70; FEV1 ≥ 80% predicted). Chronic cough and sputum production may be present. The individual is usually unaware that his or her lung function is abnormal during this period. Stage II: moderate COPD – is characterized by worsening airflow limitation (FEV1/FVC < 0.70; 50% ≤ FEV1 < 80% predicted). During exertion, individuals develop shortness of breath and cough, therefore; sometimes sputum production might be present. Usually they attempted to find medical help due to the symptoms at this stage. Stage III: Severe COPD – is characterized by a worsening of airflow limitation (FEV1/FVC < 0.70; 30% ≤ FEV1< 50% predicted), greater shortness of breath, reduced exercise capacity, fatigue, and repeated exacerbations that have an impact on patients' quality of life (Pauwels et al., 2012).

Stage IV: Very Severe COPD – is characterized by severe airflow limitation (FEV1/FVC < 0.70; FEV1 < 30% predicted or FEV1 < 50% predicted plus the presence of chronic respiratory failure). At this stage, quality of life is very appreciably impaired and exacerbations may threaten the patient's life (Pauwels et al., 2012).

Abstract

Objectives: The purpose of this study was to examine the impact of chronic obstructive pulmonary disease (COPD) and heart failure (HF) and therefore to evaluate tai chi chuan (TCC) in general health.

Background: Despite the advances in clinical care and medicine, cardiopulmonary diseases continue to be the principal cause of morbidity and mortality. In spite of the symptoms of these chronic diseases; the negative psychological status of the patients has been also demonstrated. The importance of the alleviation of the symptoms, the management of psychological disorders is essential in the progress of the disease. Complementary interventions like TCC appears to be a desirable option that can be used in rehabilitation.

Methods: A search was conducted to detect reviews, meta-analyses, systematic reviews and large randomized control trials.

Results: Several interventions along with medication contribute to the management of these diseases. A growing number of studies have demonstrated beneficial effects of TCC, such as: improvement in balance, reduction in falls, increase in social interaction; decline in cardiac risk; reduction of disease symptoms; and improvement in pulmonary system, functional and psychological status. However, most of these studies were focused on the physiological improvement rather than on the quality of life (QOL). Further studies are required to investigate the effect of TCC on QOL in patients with HF and COPD.

Keywords: Cardiopulmonary diseases, Rehabilitation, Secondary prevention, Tai Chi

1. Introduction

COPD and HF are diseases that frequently coexist in clinical practice due to common risks, most commonly: smoking, advancing age and systemic inflammation. Together they present significant challenges to healthcare professionals (Chhabra & Gupta, 2010). Despite the increased morbidity and mortality of COPD and HF, other symptoms such as: dyspnoea, fatigue, reduced exercise capacity, alternations in skeletal muscle (Padeletti, Jelic & LeJemte, 2008) and negative impact in psychological and social status of the patients can be observed. Thus, the QOL is decreased (Blinderman, Homel, Billings, Tennstedt & Portenoy, 2009). Evidence suggests that this inflammation is noted in all stages of COPD. Several systemic inflammatory markers, some of which can be found in cardiovascular disease [CVD] (IL-6, IL1-β, TNF-α, MMP-9, MCP-1, and high-sensitivity CRP), are elevated in COPD (Han, McLaughlin, Criner & Martinez, 2007). Pharmacological therapies can prevent and control the symptoms and also improve the status of health (Global initiative for chronic obstructive lung disease [GOLD], 2012). Nowadays, several studies have revealed that regular physical activity assists in the prevention of many chronic diseases and reduction of all-cause mortality, risk of cardiovascular and pulmonary diseases, injuries and obesity (Blair et al., 1995; Lee, Hsieh & Paffenbarger, 1995; Pollock et al., 1998; Hulens et al., 2002; World Health Organisation [WHO], 2002; Bauman, 2004; Lebrun et al., 2006). Moreover, exercise is beneficial in terms of improvement in well-being and health; including QOL (Kruk, 2007). TCC a form of ancient Chinese martial art, is focused more on health promotion than as a martial art and is a very popular conditioning exercise which it is been practiced all around the world (Jahnke, Larkey, Rogers, Etnier & Fang, 2010).

Previous research has demonstrated that TCC has significant benefits and it improves aerobic capacity, muscular strength, balance, QOL, and overall psychological well-being (Jahnke et al., 2010).

The rationale of this study was to review COPD and HF, the options of treatment and therefore to initially assess the effectiveness of TCC in general health.

1.1. Chronic obstructive pulmonary disease

COPD is one of the most common diseases that affects the lungs and is a major health problem (Nazir & Erbland, 2009). WHO (2012), reported that COPD was the third leading cause of death worldwide (**Figure 1**). The disease is characterised by poorly reversible airflow obstruction and an unusual inflammatory response into the lungs (MacNee, 2006). This irreversible airflow limitation is caused by an increase in the resistance of the small conducting airways (Hogg, Macklem & Thurlbeck, 1968; Van Brabandt, Cauberghs, Verbeken, & Moerman, 1983; Yanai, Sekizawa, Ohrui, Sasaki & Takishima, 1992). This lead to an increase in lung compliance due to emphysematous lung destruction (Mead, Turner, Macklem & Little, 1967) or both (Hogg, 2004).

The airflow limitation can be observed as a form of bronchitis and emphysema (Nazir & Erbland, 2009). In addition Mannino et al. (2006) stated that other phenotypes with systemic inflammation and chronic mucus hypersecretion; such as asthma should also be included with the term COPD.

This systemic inflammation has a major impact on the interaction of COPD with co-morbid conditions and on the prevalence of which rises with age (Nazir & Erbland, 2009).

These co-morbid conditions have an impact on the health outcomes in COPD patients; who die more commonly due to CVD and cancer instead of respiratory failure (GOLD, 2006).

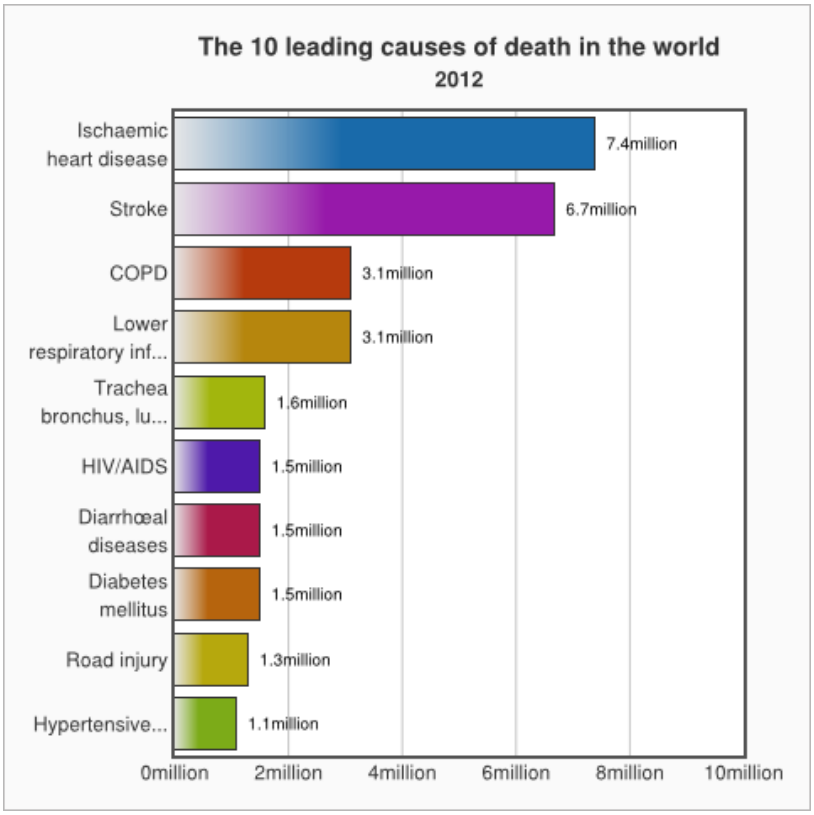

Figure 1. Leading causes of death worldwide (Adapted from World Health Organization, 2012)

1.2. Risk factors

Individuals, can be exposed to a variety of inhaled noxious gases and particles, which can cause COPD (Nazir & Erbland, 2009). Burrows, Knudson, Cline and Lebowitz, (1977), stated that also exposure to tobacco smoke is certainly the major risk factor for this respiratory disease. The intensity and duration of exposure correlate with the severity of damage.

Other investigators (Perez-Padilla et al., 1996; Orozco-Levi et al., 2006) reported that indoor-air pollution like wood-burning and other biomass-fuels leads to the development of the disease; especially on women in developing countries.

In contrast, authors (Ko & Hui, 2012) have stated that the outdoor-air pollution in comparison to the indoor-air pollution, might not associate as a risk factor. However, it increase the rate of emergency room visits for COPD exacerbations and is mostly in the elderly population (Halonen et al., 2008).

Considering the previous evidence about the risk factors, the United States of America (US) National Health and Nutrition surveys (2002) demonstrated significant airway obstruction in some people who never smoked (31.1%) and some individuals with occupational exposures (19.2%) which can also cause COPD (Hnizdo, Sullivan, Bang, & Wagner, 2002). Moreover, Tobin, Cook and Hutchison (1983) reported that a variety of genetic factors may play a role in the host-environment interaction, which in accordance to Smith and Harrison (1997), these genetic influences could be possible causes of COPD. Therefore, a number of studies (Chen, Horne & Dosman, 1991; Prescott, Bjerg, Andersen & Vestbo, 1997; Silverman et al., 2000) reported that gender may be another risk factor as women have higher risk of developing severe, early-onset COPD despite of having common exposures with men. However, the gender-based aetiology is not entirely clear (Nazir & Erbland, 2009). Prescott, Lange and Vestbo (1999) reported that the lower socioeconomic status during childhood which might be due to the exposure to particles and gases and tobacco smoke; is an additional aetiological factor. However, the bacterial and viral infection has been inconsistent evidence in the COPD pathogenesis (Sethi & Murphy, 2008).

1.3. Prevalence

The Burden of Obstructive Lung Disease study (Buist et al., 2007), examined the worldwide prevalence of COPD and demonstrated that the overall prevalence of COPD global initiative for chronic obstructive lung disease [GOLD] stage-II or higher, across 12 countries, was 11.8% and 8.5% for men and women respectively. Moreover, this study confirmed previous evidence that the disease prevalence increases with age. Estimates of <5% in persons aged 40–49 years increasing to 19–47% in men and 6–33% in women aged ≥70 years. Therefore, the prevalence of smokers was higher than non-smokers, which increased with the duration and intensity of tabaco use (Nazir & Erbland, 2009). Similar findings have been reported by the Latin American project (Menezes, Victora & Perez-Padilla, 2004) in which the post-brochodilator airflow limitation among people over age of 40 is evaluated. The prevalence of COPD is increased with age in every country (Brazil, Chile, Mexico, Uruguay, Venezuela). **Figure 2** shows the estimated prevalence of COPD for 19 countries as evaluated by Landis et al. (2014).

Figure 2. Estimated prevalence of chronic obstructive pulmonary disease by country

(Adapted from Landis et al., 2014).

1.4. Classification of Severity

GOLD (Pauwels, Buist, Calverley, Jenkins, & Hurd, 2012) classifies people with COPD based on their degree of airflow limitation. The presence of post-bronchodilator forced expiratory volume in 1-second/forced vital capacity **(**FEV1 /FVC) <0.70, confirms the presence of airflow limitation and hence COPD.

Table 1. Classification of severity of airflow limitation in COPD

Classification of chronic obstructive pulmonary disease		
GOLD1:	Mild	$FEV_1 \geq 80\%$ Predicted
GOLD2:	Moderate	$50\% \leq FEV_1 < 80\%$ Predicted
GOLD3:	Severe	$30\% \leq FEV_1 < 50\%$ Predicted
GOLD4:	Very Severe	$FEV_1 < 30\%$ Predicted

FVC: **Forced vital capacity; FEV_1:Post-bronchodilator forced expiratory volume in 1- second**

(Adapted from Pauewels et al., 2012)

1.5. Symptoms

Although COPD may not present significant symptoms, the consequences are: cough, dyspnoea and sputum production (Nazir & Erbland, 2009). Coughing is frequently the first symptom of COPD; usually intermittent during the day (Vestbo et al., 2013). Due to coughing bouts, small quantities of sputum are commonly present. Chronic cough and sputum production may lead to airflow limitation (Vestbo et al., 2013). In addition, dyspnoea which has been described by patients as heaviness and difficulty in breathing, is considered as a symptom which leads to anxiety and disability (Simon et al., 1990).

Other symptoms which may vary between days are some non-specific such as wheezing and chest tightness. In addition, tightness of the chest maybe associated with exertion (Vestbo et al., 2013).

1.6. Treatment

- ***Pharmacological therapies***

According to GOLD (Pauwels et al., 2012), pharmacological therapies are used to reduce symptoms, frequency and severity of exacerbations and therefore to improve health status and exercise tolerance.

Bronchodilator medications ($Beta_2$-antagonist, anticholinergic, methylxanthines) which increase the post-bronchodilator forced expiratory volume in 1-second (FEV_1)/alter spirometric values, are vital for the management of COPD symptoms. They are given as needed basis for relief of persistent or worsening symptoms, or on a regular basis to prevent or in order to reduce the symptoms (Pauwels, 2001).

Evidence (Belman, Botnick & Shin, 1996; O'Donnell, Lam & Webb, 1999; Celli, ZuWallack, Wang & Kesten, 2003; Celli et al., 2004) supported the effects of bronchodilator medications, which demonstrated small changes in FEV_1, which were often accompanied by larger lung volumes changes, and contributed also to a reduction in breathlessness. Belman et al. (1996) and O'Donnell et al. (1999) reported that short-acting, bronchodilators can increase exercise tolerance; whereas Dahl et al. (2001), reported that long-acting inhaled B-agonists can improve the health status possibly to a greater extent than regular short acting anticholinergics.

Moreover, also for the long-acting, Jones and Bosh (1997), Combivent trial-group (Bone Boyars & Braun, 1994) and Zuwallack et al. (2001) all stated that this medication can reduce symptoms and medication use and increase time between exacerbations in contrast to the placebo-group. According to the Combivent trial-group (1994), combining short-acting bronchodilator agents can produce a greater change in spirometry than agent itself. In addition, Zuwallack et al. (2001) reported that the combination of long-acting B-agonists with ipratropium leads to fewer exacerbations than either drug use alone. Another medication that has been used for the treatment of COPD is the glucocorticoid (Pauwels, 2001), which act at multiple points within the inflammatory cascade (**Figure 3**) (Celli et al., 2004).

Data from studies that included a large number of patients (Pauwels et al., 1999; Burge et al., 2000) recommend that inhaled corticosteroids can produce a small increase in post-bronchodilator FEV_1 and a small decline in bronchial reactivity in stable COPD. However, in regards to previous studies and the study by Vestbo et al. (1999) the inhaled corticosteroids show no effect on rate of change of FEV_1 in any severity of COPD.

Figure 3. Inflammatory cascade (Adapted from Sethi et al., 2012)

- ***Non-pharmacological therapies***

As mentioned previously, co-morbidities affect the health outcomes in patients with COPD (GOLD, 2006). Also depression and anxiety are commonly observed in this disease (Nazir & Erbland, 2009) and specifically in elderly patients (Yohannes, Baldwin & Connolly, 2000). Quint et al. (2011), reported that depressed patients have poorer QOL and Cully et al. (2006) specified that up to 37% of the elderly with COPD may have anxiety, which is also associated with poor QOL.

Ries, Kaplan, Limberg and Prewitt (1995) commented that education alone does not improve the function of the lungs; however Celli (1995) stated that it can improve the skills and ability to cope with illness and health status. Sirey, Raue and Alexopoulos (2007) reported that education might be helpful for depressed COPD patients.

In addition, Anthonisen et al. (1994) reported that education is effective in order to set goals, including smoking cessation. Cigarette smoking is a major known risk factor, and premature and accelerated development of panlobular emphysema and decline in lung function occurs in many smokers (Pauwels et al., 2012). GOLD (Pauwels et al., 2012) reported that comprehensive tobacco control policies and programmes with clear non-smoking messages should be delivered.

- ***Oxygen therapy***

Supplemental long-term oxygen therapy can improve the survival, exercise, sleep and cognitive performance in hypoxaemic patients (Siafakas et al., 1995; Vestbo et al., 2013). According to Tiep, Barnett, Schiffman, Sanchez and Carter (2002), oxygen sources include: gas, liquid and concentrator; while oxygen delivery methods include nasal continuous flow, pulse demand, reservoir cannulae and transtracheal catheters.

- ***Rehabilitation and exercise***

Vestbo et al. (2013) recommended that patients attend pulmonary rehabilitation (oxygen therapy, ventilator support). It has been reported to reduce the symptoms, improve the QOL and increase physical and emotional participation in activities of daily life (ADL). GOLD (Pauwels, 2001) reported that exercise training can be used as a treatment, although did not offer any recommendations. More recently, Vestbo et al. (2013) stated that patients at all stages of the disease could benefit from exercise with improvements to exercise tolerance and symptoms.

Importantly, Ries et al. (2007) commented that both low-intensity and high-intensity exercise produce clinical benefits, whereas aerobic activity, lower-extremity exercise, unsupported upper-extremity and strength training, may provide additional benefits and be more effective due to of the similarities that they have with ADL.

The frequency and duration of training vary from daily to weekly, with 10 minutes to 45 minutes and an intensity from 50% peak oxygen consumption (VO2peak) (Mahler, 1998). The length of the exercise has not been investigated. However most of the studies (Troosters, Casaburi, Gosselink & Decramer, 2005) involved patients in fewer than 28 sessions (Pauwels et al., 2012) and Finnerty, Keeping, Bullough and Jones (2001) reported that the minimum length of an effective programme is six-weeks.

- ***Tai Chi Chuan***

Yeh et al. (2010) found that TCC a Chinese martial art, which is used as an intervention for health and could be suitable for COPD patients due to its characteristics. As it was estimated, TCC is about 1.6 – 4.6 metabolic-equivalent-of-task units (METs) and 50–74% of maximum heart rate (MHR), depending on the age of the individual and the intensity of practice (Schaller, 1996; Fontana, 2000). TCC provides mild to moderate aerobic activity, and lower-extremity, unsupported upper-extremity, and core-strength training (Yeh et al., 2010). In addition TCC includes elements of breathing and respiratory muscle training. Along with stress management are important components for the management of COPD (Yeh et al., 2010). Data from studies about TCC benefits are reported in section 4 of this review.

2. Heart Failure

According to the National Institute for Health and Care Excellence [NICE] (2010), HF is "a complex clinical syndrome of symptoms and signs that the heart as a pump is impaired". The HF aetiologies can be grouped into those with: impaired ventricular contractility (myocardial infarction [MI], cardiomyopathy, transient myocardial ischemia), increased afterload (aortic stenosis, hypertension) or impaired ventricular relaxation (left ventricular [LV] hypertrophy, hypertrophic/restrictive cardiomyopathy, transient myocardial ischemia) and filling (mitral stenosis, pericardial constriction/tamponade) (Lilly, 2011).

2.1. Risk factor

McMurray et al. (2012) stated, that the causes of HF differs depending on the population; suggesting that hypertension and coronary artery disease is the most common origin in Western society. With its progression it results a MI which damages the LV (Timmis & McCormack, 2003). Additionally, other major contributory factors of HF is the infection of the heart, medication, alcohol, arrhythmias and diseases of the valve (McMurray et al., 2012). Furthermore, other investigators (Bui, Horwich & Fonarow, 2010) reported other minor clinical risk factors such as: smoking, dyslipidaemia, chronic kidney disease, anaemia and sedentary lifestyle.

2.2. Prevalence

Mosterd and Hoes (2007) reported that in developed countries, approximately 1-2% of the adult population has HF with the prevalence rising to≥10% among individuals 70 years old or more. In the Rotterdam study (Mosterd et al., 1999) they indicated that hypertension was more of a contributing factor in women than men; hypertensive women were 2.6 times more likely to develop HF than women without hypertension. However, hypertensive men were at no higher risk than their non-hypertensive counterparts. Moreover, Bibbins-Domingo et al. (2004) concluded that women with diabetes and an elevated body mass index or renal insufficiency were at the highest risk. The annual a HF incidence rates were 7% and 13%, respectively. Although, women without diabetes along with the absence of other risk factors, had HF incidence of 0.4%. In the Coronary Artery Surgery Study (Hoffman, Psaty & Kronmal, 1994) smoking was independently associated with a 47% increased risk of developing HF. The Studies Of Left Ventricular Dysfunction [SOLVD] (SOLVD Investigators, 1991) found that 99 of ex-smokers had a 30% lower mortality than current smokers, a benefit that was present within 2 years after smoking cessation.

2.3. Signs and symptoms

According to the American Heart Association (Yancy et al., 2013), congestive HF (CHF) is a type of HF which is characterized by the fluid collection in the body tissues. HF and CHF are two terms which used inter-changeably. Moreover, the Scottish Intercollegiate Guidelines Network [SIGN] (2007), reported that the elevated jugular venus pressure, pulmonary crackles displaced apex beat and peripheral oedema are the main clinical signs.

The shortness of breath, swelling of ankles and fatigue have been reported as the main symptoms (SIGN, 2007).

2.4. Classification of Severity

McMurray et al. (2012) stated that although the symptoms bring patients to medical attention, although are not specific and therefore unhelpful. This results in difficulties in diagnosis. The New York heart association functional classification [NYHA] (1928; 1994) has been used to determine the severity grade of functional limitations (McMurray et al., 2012).

Table 2. Heart failure classification

New York Heart Association functional classification
I: Patients have cardiac disease but without the resulting limitations of physical activity. Ordinary physical activity does not cause undue fatigue, palpitation, dyspnoea or anginal pain **II:** Patients have cardiac disease resulting in slight limitation of physical activity. They are comfortable at rest. Ordinary physical activity results in fatigue, palpitation, dyspnoea or anginal pain **III:** Patients have cardiac disease resulting in marked limitation of physical activity. They are comfortable at rest. Less than ordinary physical activity causes fatigue, palpitation, dyspnoea or anginal pain **IV:** Patients have cardiac disease resulting in inability to carry on any physical activity without discomfort. Symptoms of cardiac insufficiency or of the angina syndrome may be present even at rest. If any physical activity is undertaken, discomfort is increased

(Adapted from Raphael et al. 2007)

2.5. Treatment

- ***Pharmacological treatment***

The goals of treatment for patients diagnosed with HF, are to relieve the symptoms and clinical signs, prevent hospital admission and improve survival (McMurray et al., 2012).

The recommended medication by NICE-guidelines (2010) for the management of HF are: angiotensin converting enzyme (ACE-inhibitors), diuretics, B-blockers, aldosterone antagonist, digoxin, angiotensin-2 receptor antagonists, amiodarone, aspirin, statins, anticoagulation, inotropic agent and calcium channel blockers. However, ACE-inhibitors and in case of side-effects; angiotensin-2 receptor agents antagonist along with B-blockers and diuretics are considered as the core medication for HF patients (Lambert, 2011). In **table 3** are stated the effects of the core medication in mortality.

Table 3. Mortality rates reduction based on core-medication

	Medication	
Studies		**Mortality Reduction**
Domanski et al. (2003)	B-blockers	29%
Flather et al. (2000)	ACE-Inhibitors	26%
Garg and Yusuf (1995)	ACE-Inhibitors	23%
Granger et al. (2003)	ARB's	23%
Cohn and Tognoni (2001)	ARB's	No effect

Abbreviations: B-blockers, Beta Blockers; ACE-Inhibitors, Angiotensin Converting Enzyme Inhibitors; ARB's, Angiotensin Receptor Blocker.

The majority of patients with HF present a fluid retention resulting in oedema of the ankle, pulmonary oedema or both leading to dyspnoea. Hence, a treatment with diuretic medication is required in order to relieve symptoms such as: oedema and dyspnoea SIGN (2007). Although the evidence from this meta-analysis were not strong due to a number of small, poor quality studies; the evidence indicates that there is a benefit from diuretic therapy for patients with dyspnoea or oedema. SIGN (2007) suggested that the dose of diuretics should be individualised in order to reduce the fluid retention without over treating; which may produce dehydration or dysfunction of the renal system.

- ***Non-pharmacological therapy***

SIGN (2007) reported that "patients with HF demonstrated high levels of frustration with progressive loss of function, social isolation and the stresses of monitoring a complex medical regimen". Moreover, Levenson, McCarthy, Lynn, Davis and Phillips (2000) stated that patients could exhibit psychological stress, due to the need for assistance with ADL, and social life isolation, low income and reduced daily function.

Yancy et al. (2013), stated that education and support are important not only for HF patients but also for their families. In addition, Ditewig, Blok, Havers and Van Veenendaal (2010); Yehle and Plake (2010) and Joulliere et al. (2013) reported that patients' education related to in HF self-care declines the disease morbidity and mortality, the rates of hospital-readmission and psychological stress and improves the self-efficacy. Consequently, all these factors contribute to the improvement of QOL.

The European Society of Cardiology [ESC] (Dickstein et al., 2008), reported that as smoking is a known major risk factor for CVD, patients should attend smoking cessation sessions. Observational studies (Evangelista, Doering & Dracup, 2000; Suskin, Sheth, Negassa & Yusuf, 2001) supported a relationship between smoking and increased HF mortality. However, no studies evaluated the effects of smoking cessation-intervention (SIGN, 2007). HF patients who are smokers should be provided with smoking cessation sessions. In addition, obese individuals who are diagnosed with HF are advised to reduce their weight in order to improve their well-being (ESC, 2008).

- ***Rehabilitation and exercise***

Piepoli, Flather and Coats (1998), stated that physical inactivity is common among HF patients and worsen the condition. Several studies (Smart & Marwick, 2004; Piepoli, Davos, Francis & Coats [ExTraMATCH], 2004; Rees, Taylor, Singh, Coats & Ebrahim, 2004) demonstrated that exercise training, declined hospitalization and mortality in contrast to the usual care alone. Therefore it improves exercise tolerance and the health related quality of life (HRQOL). ESC (Piepoli et al., 2011) reported that interval training is more effective for improving exercise capacity than continuous training. Moreover, inspiratory muscle training can improve exercise capacity and QOL. According to Piepoli et al. (2011), the training sessions should be of a duration up to 45-60 minutes, on 3-5 days/week at moderate intensity at 40-70 heart rate reserve.

- ***Tai Chi Chuan***

TCC movements are ideal for older people who are likely to require cardiac rehabilitation (Hong, Li & Robinsons, 2000). TCC requires moderate work intensity without exceeding 50% of maximum oxygen uptake (VO_2max) (Taylor-Piliae & Froelicher, 2004). Evidence relating to TCC benefits are reported in section 4 of this review.

3. Tai Chi Chuan and its general health benefits

The growing demographic of older population is a worldwide phenomenon (Gorman, 2002). Considering the life expectancy, more than the half of all older adults (65+ years) will suffer from one age-related physical or mental disorder (Standage & Duda, 2004).

TCC is a form of ancient Chinese martial art; nowdays it is focused more on health promotion than as a martial art and it a very popular Chinese conditioning exercise which is has been practiced worldwide (Cheng, 2007). Previous studies supported that TCC-training can be beneficial and improve cardiorespiratory function, strength, flexibility, motor and balance control, peripheral circulation, function of the endothelial, blood lipid, immune function, psychological and social function (Lan et al., 1996; Wolfson et al., 1996; Jacobson, Ho-Cheng, Cashel, & Guerrero, 1997; Lan et al., 2000; Hong et al., 2000). One of the purposes of this present study is to further understand the health benefits of TCC, which will demonstrated below.

3.1. Falls and balance

A significant public health problem which still affects the third to half of population >65 years old; is the falls (Blake et al., 1988; Province et al., 1995; Gillespie et al., 2000).

Due to ageing and inactivity, increased physical difficulties constrain older people to lose their independence and they may become disabled and dependent (Shephard, 1993). A Cochrane review (Gillespie et al., 2000), included a trial which evaluated the effects of TCC and revealed that it is a very beneficial exercise intervention which can reduce the risk of fall by 47%. In accordance with other studies (Jacobson et al., 1997; Wolf, Barnhart, Ellison, & Coogler, 1997; Li et al., 2005) state that older people who practiced the martial art reduced their risks; numbers and fears of falling and improved functional balance and physical performance.

Osteoarthritis is a common problem in the elderly population (Wang et al., 2009). A growing number of studies that examined patients diagnosed with osteoarthritis and reduced balance (Kutner, Barnhart, Wolf, McNeely & Xu, 1997; Hartman et al., 2000; Song, Lee, Lam & Bae, 2003; Fransen, Nairn, Winstanley, Lam & Edmonds, 2007; Brismée et al., 2007) represented that TCC can improve their balance which therefore resulted in increased confidence in balance and movement.

However the results of these studies need to be interpreted in caution due to low levels of adherence, short follow-ups, variation in TCC styles and heterogeneous types of OA.

3.2. Flexibility and muscular strength

Due to the routine stretching exercises in the warm-up phase, TCC is able to improve the flexibility of the muscular system (Lan, Lai & Chen, 1998). Lan et al. (1998), reported that males and females who practise TCC, increased thoracolumbar flexibility by 11 degrees (p<0.05) and 8.8 degrees (p<0.05) respectively. Similarly, another study (Hong et al., 2000), evaluated the effects of TCC on flexibility and reported significant better scores in total body rotation on both sides (p<0.01). Lan et al. (1998), also found improvement in the muscular strength of knee extensors such as an increase of 18.1% (p<0.01) for males and 20.3% (p<0.05) for females. In addition, a study in 2007 (Woo, Hong, Lau & Lynn) investigated the effects of TCC on bone mineral density (BMD) and demonstrated no benefit to men.

However hip bone loss was relatively unchanged for females in TCC-group (0.07±0.64) and resistance-training (0.09±0.62) compared to a sedentary control-group (−2.25±0.6).

A possible reason could be the intensity of TCC which is insufficient in men in contrast to women who are more likely to be frail. However, TCC as an exercise provides sufficient intensity to produce a beneficial effect on BMD (Woo et al., 2007).

3.3. Blood Lipids

Data from studies (Tsai et al., 2003; Zhang & Fu, 2008; Lan et al., 2008a; Lan et al., 2008b) demonstrated that individuals who performed TCC had a reduction in total cholesterol, triglyceride levels, in contrast to the control-group. Although, Thomas et al. (2005) reported decreases in serum blood glucose levels, no conclusions about the effects of TC on serum lipid were reported.

3.4. Psychology, Well-being and Quality Of Life

A number of studies (Welsh, Kymn, & Waters, 1997; Hartman et al., 2000; Wall, 2005; Cheon, Sung, Ha & Kim, 2006; Kin, Toba, & Orimo 2007; Liu, Miller, Burton, Chang & Brown, 2013) revealed that TCC has the potential to alter the tension, depression, anxiety, general mood, QOL, increase confidence and self-efficacy. However, these studies demonstrated several limitations such as: different range of disorders, gender, age, and different duration of the programme.

3.5. Cardio-pulmonary conditions and risk factors

Investigators, also examined the Chinese martial art in some other conditions, including CVD (Channer, Barrow, Barrow, Osborne & Ives, 1996; Lan, Chen, Lai, & Wong, 1999) and cardiorespiratory fitness (Lan, Lai, Wong & Yu, 1996). Lan et al. (1999) revealed an Improvement in VO_2max and in peak work rate in patients post-surgery; while Channer et al. (1996), Wang (2008), Zhang and Fu (2008) and more recently Ahn and Song (2012), demonstrated an improvement of glucose control, a decline in blood glucose, lower fasting plasma glucose and glycated serum proteins and higher fasting plasma insulin. However, the dropout rate of some studies was high, the type of diabetes differed and the sample sizes were small. Moreover, participants who performed TCC for 3-months (Taylor-Piliae et al., 2006; Zhang & Fu, 2008) to 12-months (Lan et al., 2008b; Thomas et al., 2005) duration had a significant reduction in their blood pressure and heart rate.

However, the TCC-style, duration, frequency, sample size and age and activities that included in each session were different, and as a conclusion different principles of the exercise may affect different the individuals.

According to Lan, Chen, Lai and Wong (2004) “TCC and Qigong (healing exercise) can be combined to facilitate energy cultivation and improve the benefits of exercise”. Data by Reuther and Aldridge (1998), demonstrated a decline in peak-flow variability, reduction in hospitalization rate, less sickness, reduced antibiotic use and fewer emergency consultations resulting in reduced treatment costs. However, the sample had a variety and degree of illness which may affected the results.

Lee, Lee, Choi and Chung (2003) revealed that an improvement in the ventilatory functions: forced vital capacity and forced expiratory volume per second were increased; something which was not observe in the control-group.

4. Conclusion

The purpose of this study was to overview COPD and HF and to provide the options of treatment. In addition, another aim was to review the potential of TCC as a mode of physical exercise in the general population and to provide directions for the future. For better understanding, a main emphasis on the definition, risk factors and causes, prevalence, signs and symptoms, classification and treatment of the disease were given in this review. The review demonstrated that several interventions such as: smoking cessation, education, nutrition management, psychological interventions and exercise training, included in the sessions of rehabilitation for patients diagnosed with COPD and HF are beneficial.

These interventions along with the recommended medications, contribute to the modification of the disease risk factors, improve exercise tolerance, reduce the symptoms and therefore reduce mortality and enhance QOL.

Therefore, the Chinese martial art and nowadays complementary intervention was proved to improve significantly the diseases progression, reduce the symptoms; improve the QOL and well-being of the individual. However, until now it remains unclear how TCC is affecting these outcomes and leading to improvement. Due to the wide range of TCC techniques and styles that authors used in their studies, the duration of the session, the age, the disease severity and the fitness level of the individual; different results were demonstrated. In addition, according to data from the studies, the outcomes are isolated, and do not focus on the effects of TCC in HRQOL. As these chronic diseases affect the function and QOL of the patient, it is needed to be evaluate the efficacy of the Chinese intervention in this area.

5. Aims, objectives and research questions

The aim of this systematic review was to determine if TCC can improve the QOL of patients with HF and COPD. The objective was to; identify previous studies which examined the effectiveness of the Chinese martial art in patients with these diseases, describe the exercise interventions and determine the outcomes of HRQOL update the systematic review.

Table 4. Research questions

Primary hypothesis	Secondary hypothesis
H_0: There is not difference in the quality of life after practising the Chinese martial art Tai chi chuan.	**H_0:** There is not difference on the ł physical outcomes after practising Tai chi chuan.
H_1: Tai chi chuan intervention has beneficial effect on the score of quality of life in the specific disease questionnaires.	ł **H_1:** Tai chi chuan intervention has beneficial effect on physical outcomes.

ł **Physical outcomes**, exercise capacity; oxygen consumption (VO_2); balance; blood pressure; catecholamines' and neurohormones; serum biomarkers; sleep quality; perceived social support; mood.

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Does Tai Chi Chuan Improve the Quality Of Life of patients with Cardio-Pulmonary disease?

A Systematic Review

(Adapted from Barrie Tai Chi & Qigong, 2010)

Keywords: Taiji, Chronic Obstructive Pulmonary Disease, Heart Failure, Health-Related Quality Of Life

Words Count: 4, 346

Journal Selection

Non-pharmacological therapies like complementary and alternative therapy (CAM); is given in addition to regular treatment (Uhlig, 2012). Tai chi chuan (TCC) a Chinese body-mind and martial art is considered as a complementary therapy (Uhlig, 2012). The selection of "The Complementary Therapies in Medicine" journal was considered to be the appropriate journal due to its publication topics. It is a journal reviewing a variety of articles including primary research, reviews and opinion pieces. The journal coverage a variety of CAM forms interventions and encourages the exploration of the methodology of research.

Does Tai Chi Chuan Improve the Quality Of Life of patients with Cardio-Pulmonary disease?

A Systematic Review

Objectives: To determine the effects of Tai chi chuan on health related quality of life in patients with cardiac and pulmonary disease.

Background: Complementary and alternative medicine has been substantially used in patients suffering with various chronic illnesses and is demonstrated to be effective for the improvement of both physical and psychological components. Tai chi chuan, a Chinese martial art is one form of complementary and alternative medicine.

Methods: Three databases (MEDLINE, CINHAL and SportDirect) were searched from 2000 to 2014 for related studies. Randomized control trial studies which enrolled patients with heart failure and chronic obstructive pulmonary disease and examined the effects of tai chi on quality of life, were included in this review. One single reviewer extracted the data, assessed any risk of bias and evaluated the quality of papers.

Results: The search strategy from the three databases identified a total of 110 records, therefore, following a process of the eligibility criteria; six studies were included in the review. These studies demonstrated that tai chi improved patients' quality of life.

Conclusion: This Chinese martial art provided multi-benefits which can contribute to the improvement of quality of life scores. However, it remains unclear how tai chi chuan may work in affecting patients' quality of life.

Keywords: Taiji, Chronic obstructive pulmonary disease, Heart failure, Health-related quality of life.

Words Count: 4,343

Introduction

Heart failure (HF) and chronic obstructive pulmonary disease (COPD) are global epidemics, each affecting in excess of 10 million patients (Swedberg et al., 2005; Global initiative for chronic obstructive lung disease [GOLD], 2006). These diseases sustain morbidity and mortality; therefore present challenges for health care professionals (Swedberg et al., 2005). Apart from this, they have deleterious effects which contributes to the reduction of quality of life (QOL) (Li, Hua & Zhang, 2014).

Tai chi chuan (TCC) sometimes known as "Taiji" is a form of traditional mind-body exercise which originated in China as a martial art (Lewis, 2000). It is a low-intensity physical activity, in which the body performs spiral and circular movements which stimulate the body's meridians and acupuncture points and improve the health status (Lewis, 2000). TCC as a moving meditation focuses on gentle movements and deep breathing (Jahnke, Larkey, Rogers, Etnier & Lin, 2010). There are different styles of TCC, however the most popular styles are: Chen, Yang, Sun, Wu and Hao; each one has its own characteristics, but all styles share the same principles focusing on relaxation (Yan & Downing, 1998).

It has been introduced in randomized control trials (RCT) as an alternative exercise intervention and it has demonstrated beneficial effects on flexibility, balance and movement control, pain, fatigue, cardiovascular fitness, stress reduction, mood enhancement, and psychological well-being (Jahnke et al., 2010). However, its effects on health related quality of life (HQOL) are not well understood (Li et al., 2014).

The primary aim of this systematic review was to summarise and evaluate related RCT studies which examined the effects of the Chinese martial art on QOL for patients with HF and COPD.

Methods

Overview of the systematic review process

The review was conducted and reported in accordance with the preferred reporting items for systematic reviews and meta-analyses (PRISMA) statement (Moher, Liberati, Tetzlaff, Altman, & Prisma Group, 2009). **Appendix 2**, provides a completed PRISMA 27 item checklist of the systematic review reporting items.

Search strategy

The research proceeded in two phases. During the first phase a comprehensive literature search of a number of scientific databases, such as ScienceDirect, MEDLINE and Cumulative Index to Nursing and Allied Health Literature [CINAHL] (**Appendix 5**) was conducted in order to identify full-text articles during the years 2000-2014. Initially searches were performed from March 2014 up to the end of June 2014. The medical subject headings (MeSH) “heart failure”, “chronic obstructive pulmonary disease” AND “tai chi” were used alone or in combination. Each specific phrase was combined with the Boolean operator to limit the search and make it more specific (**Appendix 5**).Terms such as “heart failure” AND “tai chi”, “chronic obstructive pulmonary disease” AND “tai chi” were searched. Depending on the database, tai chi; chronic obstructive pulmonary disease; heart failure; clinical trials were selected as topic option to limit the publications. In addition, articles were also searched manually (**Appendix 6**) in order to maximize the amount of investigations involved in the current review. In the second phase, a more detailed search was performed on the reference lists from the original research papers; to identify RCTs from previously published reviews.

Eligibility criteria

In order to define and frame the research questions the Population(s), Intervention(s), Comparator(s), Outcome(s) and Study Design (PICOS) were used (O'Connor, Green & Higgins, 2011) (**Appendix 4**). The titles and abstracts of all records were screened initially against the basic initial eligibility criteria by one single reviewer (**Appendix 4**). A single failed eligibility criterion was sufficient for a study to be excluded from a review (Higgins & Deeks, 2011). Moreover, the records that remained after initial eligibility screening, were therefore screened against the full eligibility criteria outlined in **Table 1**.

Primary and secondary outcome

All records were required to report QOL as a primary or secondary outcome measure. The primary outcome of this review was changes in QOL in patients with HF and COPD, who practiced any form of the Chinese martial art TCC. The secondary outcome of this review was to report other physical and psychological effects of TCC-intervention, measured via validated tools.

Data extraction and assessment of risk of bias

For each RCT included, one single reviewer extracted data from the studies and therefore used the Cochrane risk of bias tool. The tool mainly consists of seven domains: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data; selective outcome reporting and other biases (**Figure 2**).

Quality assessment

The Oxford quality scoring system (Jadad et al., 1996) was used to assess RCTs' methodology quality. The assessment of methodology was performed only to assess the quality and did not exclude any records based on the score. The Jadad-scale contains a total of three questions, two concerning randomisation and the blinding of the study with an additional question evaluating the reported dropouts and withdrawals (**Appendix 3**).

Table 1. Full eligibility screening criteria

Inclusion Criteria	Exclusion Criteria	PICOS
Was the study a RCT?	Study designs other than RCT Quasi experimental studies	Study
Was the study published in English?	Published in other languages Duplicates Abstract and pilot-studies publications Not full-text free records	
Did the study include males/females with HF or COPD?	Included subjects with disease risk factors	Population
Was the intervention TCC and was it combined with another type of exercise?	Performed only Chi Kung/Qigong	Intervention
Did the study assess the QOL? Outcomes measured via MLHF; SGRQ; CRQ	Not-reported outcomes as QOL Report only psychological outcomes Measurements via other questionnaires	Outcomes
Was the intervention TCC compared with another type of exercise? Studies that compared Tai Chi Chuan with other exercise forms, placebo, non-therapy		Comparison

Results

Identification of records and study selection

In **Figure 1**, is presented the flow of detection and inclusion of the records through the systematic review.

Figure 1. PRISMA diagram for included studies (Moher et al., 2009)

Description of included studies

The search strategy from the three databases identified a total of 110 records. Following a process of the eligibility criteria, 104 records were excluded, including ten duplicate records (**Figure 1**). The remaining six records (**Appendix 8**) met the full eligibility criteria (**Table 1**) and were included in the final review.

A summary of the studies' characteristics is stated in **Table 2**. Three of the studies (Chan, Lee, Suen & Tam, 2010; Leng, McKeough, Peters & Alison, 2012; Chan, Lee, Lee, Sit & Chair, 2013) examined the effects of TCC on COPD patients, whereas the other three remaining studies (Yeh et al., 2004; Yeh et al., 2008; Yeh et al., 2011) enrolled patients with HF. Four of the studies (Chan et al., 2010; Yeh et al., 2011; Leng et al., 2012; Chan et al., 2013) used a single-blind randomization. In addition, two of the studies (Chan et al., 2010; Chan et al., 2013) used the same sample size; however both were included in the review.

The studies examined adult individuals between 55 and 74 years old of both genders. However, the number of males and females was not equal. The sample size (**Table 2**) of participants ranged between 18 and 206 and vary regarding the ethnicity, disease stage, risk factors, coexisting disease, and type of medication. Overall, the 598 participants were allocated to a structure programme of TCC (n=232) or to a comparison exercise (n=138) or control-group (n=228).

The primary outcome of the four studies (Yeh et al., 2004; Chan et al., 2010; Yeh et al., 2011; Chan et al., 2013) was the QOL (**Table 4**). In contrast, one of the two remaining studies (Yeh et al., 2008) aimed to assess the effects of the Chinese martial art on sleep which has an impact on the QOL outcome. Additionally, Leung et al. (2012) had as a primary outcome, the endurance shuttle walk time and as a secondary outcome the QOL.

Depending on the disease, the participants were evaluated with Minnesota living with heart failure questionnaire (MLHF), St. George's respiratory questionnaire (SGRQ) and chronic respiratory questionnaire (CRQ) (**Appendix 1**). Alternatively, the two studies undertaken by Chan et al. (2010; 2013) used the same study design, but one used the SGRQ in Chinese and one used the questionnaire in English. These questionnaires were designed specifically to measure different dimensions of QOL under the influence of HF and COPD treatments respectively (**Appendix 1**).

Table 2. Characteristics of studies and participants

Study	Study Location	Groups	Sample Size (n)	Mean Age (Years)	Disease	Type of TCC
Chan et al. (2013)	Hong Kong	Exercise Control TCC	69 67 70	73.6±7.5 73.6±7.4 71.7±8.2	COPD Mild, Moderate, Severe	BRTCQ
Chan et al. (2010)	Hong Kong	Exercise Control TCC	69 67 70	73.6±7.5 73.6±7.4 71.7±8.2	COPD Mild, Moderate, Severe	BRTCQ
Leung et al. (2012)	Australia	Exercise Control	19 19	73±8 73±8	COPD	Sun
Yeh et al. (2011)	USA	Exercise Control	50 50	68.1±11.9 66.6±12.1	HF I- III NYHA	Yang
Yeh et al. (2004)	USA	Exercise Control	15 15	66±12 61±14	CHF and LVEF ≤40%	Yang
Yeh et al. (2008)	USA	Exercise Control	8 10	64.2±16.2 54.7±11.8	CHF and LVEF ≤40%	Yang

Abbreviations: USA, United States of America; HF, Heart Failure; COPD, Chronic Obstructive Pulmonary Disease; NYHA, New York Heart Association Classification; LVEF, Left Ventricular Ejection Fraction; BRTCQ, Breathing regulating Tai chi Qigong.

Tai chi chuan Intervention characteristics

Three studies (Yeh et al., 2004; Yeh et al., 2008; Yeh et al., 2011) examined the effects of the Chinese martial art in HF patients using the Yang-style (**Appendix 7**). Whereas, in one of the three studies which enrolled COPD patients; participants practised the Sun-style (Leng et al., 2012). In the two remaining studies (Chan et al., 2010; Chan et al., 2013), Qigong (**Appendix 1**) was performed in combination with TCC. This form is called Tai chi Qigong (TCQ or Breathing regulating Tai chi Qigong [BTCQ]). Thereby of the differences of TCC styles, the frequency of TCC exercise programme was mainly 2 times per week, while the time of session and length of programme was 1 hour and 12 weeks for all the studies.

Other intervention characteristics

Five out of six studies (Yeh et al., 2004; Yeh et al., 2008; Chan et al., 2010; Yeh et al., 2011; Chan et al., 2013) reported that participants in the control-group were involved in education sessions, community gatherings, and activities of daily life (ADL). Whereas the remaining study (Leung et al., 2012) stated that participants continued only with their usual medication. Although, in two studies (Chan et al., 2010; Chan et al., 2013); the participants who enrolled into the exercise-group, performed walking and breathing techniques without supervision (**Table 3**).

Table 3. Characteristics of exercise and control group

Study	Group	Type of Intervention	Frequency (days/week)	Time	Duration (months/weeks)
Chan et al. (2013)	Exercise Group	Breathing Techniques Walking	7/week	1 hour	3 months
	Control Group	Medication Weekly Gatherings ADL			
Chan et al. (2010)	Exercise Group	Breathing Techniques Walking	7/week	1 hour	3 months
	Control Group	Medication Weekly Gatherings ADL			
Leung et al. (2012)	Control Group	Medication			
Yeah et al. (2011)	Education Group	Educational Sessions	2/week	1 hour	12 weeks
Yeh et al. (2004)	Control Group	Medication Dietary counselling Exercise advice			
Yeh et al. (2008)	Control Group	Medication Dietary counselling Exercise advice			

Abbreviations: ADL, Activities of Daily Life

Primary outcome

A summary of the results is stated in **Table 4**. One of the single-blinded studies (Yeh et al., 2011) reported that HF participants demonstrated an improvement in the scores of QOL. The difference in the mean values was *less in the post intervention score by -19 points (p=.02) in contrast to the education-group. Similar findings were reported by another study (Yeh et al., 2004); also demonstrating an improvement (-25 points, p=0.001) on the questionnaire that assessed the QOL.

In contrast, the remaining study (Yeh et al., 2008) which also enrolled HF patients, demonstrated an improvement on sleep after practising TCC for 12-weeks. Regarding this progress on sleep (high-frequency coupling [HFC]), it contributed to an improvement on QOL in contrast with the participants of control-group (p<0.01). In addition, an increase in low-frequency coupling (LFC) was associated with poor QOL (p=0.02).

As for the studies which examined the impact of martial art on the COPD population; one study (Chan et al., 2010) demonstrated greater improvements during the 3-month in the symptom (p=0.010) and activity domains (p=0.035) of the questionnaire. However, these differences in the total *SGRQ score (p=0.065) were not significant.

Three years later, another study (Chan et al., 2013) which used the same sample with the previously reported study (Chan et al., 2010), demonstrated statistical improvements in the 6-month, in all domains of SGRQ (p=0.002). Despite the symptoms domain (p<0.001); the statistically significant results were not clinically significant. In contrast, the exercise-group had clinically significant deterioration in all domains; expect the symptom domain.

*****A lower MLHF and SGRQ score indicates better quality of life

The last study (Leung et al., 2012) which is included in the review, used the Sun-style TCC and reported that the change on *CRQ scores exceeded the minimum clinically important difference (MID) in nearly all domains in the TCC compared to the control-group (**Appendix 1**). It demonstrated an increased total score with a mean difference (95% Confidence interval [CI]) of 11 points (4 to 18).

*A higher CRQ score indicates better quality of life

Table 4. Summary of the main effects of Tai chi chuan on the health related quality of life

Study	Groups	Outcomes (Baseline)	Outocmes (End)	P-value	Coefficient interval 95% CI Mean difference between groups
1.Chan et al. (2013)†	**TCC**	42.69±15.13	40.29±16.94	(***p*=0.002**)	
	Control	39.37±16.18	44.09±15.01		
	Exercise	36.97±16.56	41.60±15.74		
1.Chan et al (2010)†	**TCC**	42.7±15.1	41.8±15.2	(***p*=0.065**)	
	Control	39.4±16.2	43.4±14.8		
	Exercise	37.0±16.6	40.5±16.1		
2.Leung et al. (2012)*	**TCC**	5.9±5	6.5±5		**11 (95% CI 4 to 18)**
	Control	4.6±1	4.6±1		
3.Yeh et.al. (2011)†	**TCC**	×28 (12, 47)	9 (2, 25)	(***p*=.02**)	
	Education	21 (11, 52)	22 (4, 43)		
3.Yeh et. al. (2004)†	**TCC**	43±21	6±23	(***p*=0.001**)	
	Control	44±20	53±25		
3.Yeh et. al. (2008)†	**TCC**	NA	-17±14	(***p*<0.01**)	
	Control	NA	7±10		

Abbreviations: 1. St. Georges Respiratory Questionnaire; 2. Chronic Respiratory Questionnaire; 3. Minnesota Living with Heart Failure; †lower scores show improvements; * increased scores show improvement; × Median (Q1, Q3).

Secondary outcomes

A summary of the secondary outcomes is stated in **Table 5; Table 6; Table 7 and 8**. Two studies reported the effectiveness of TCC on psychology and mood. One study (Leung et al., 2012) demonstrated improvements [-2 (95% CI: -2 to -0.5); -2 (95% CI:-3 to 0.02)] on anxiety and depression respectively; whereas the other study (Yeh et al., 2011), demonstrated significant improvement in the scores of the profile of mood states (subscales of mood disturbances, depression and vigor) [(p<.001); p=.004; p<.001)] and cardiac exercise self-efficacy instrument (p<.001) in TCC-group (**Appendix 1**). Nonetheless, no other significant changes were observed in other subscale of profile mood states.

Significant improvement in balance (-12.4 mm, 95% CI: -21 to -3) and muscle strength (right leg 95% CI: 23 [14.5 to 33.5]; left leg 95% CI: 17.8 [6 to 29]) were also demonstrated in one study (Leung et al., 2012). In addition, TCC increased significantly the high frequency-coupling [HFC] (associated with sleep stability) (p=0.04) and decline significantly low frequency-coupling [LFC] (associated with unstable sleep) (p<0.01) compared to the control-group (Yeh et al., 2008).

Two studies measured the perceived social support. It was demonstrated that the lowest among the three categories of *MSPSS-questionnaire was the support from friends with a mean item score 3.21 (which fell below the 3.5 MID). The support from family had a mean score of 5.45 at baseline (fell well above the MID point of 3.5) and the support from significant others was 3.74 (which fell around the MID point of 3.5) (Chan et al., 2013). It was reported that the participants of the TCC-group; had an improvement (+16.6%) in the in social support from friends (p=0.044).

Therefore, no differences were demonstrated from family (p=0.602) and significant others (p=0.056). In contrast, the other study (Chan et al., 2010) found no differences between these domains.

Four studies assessed the effects of TCC on exercise capacity and three of them reported an outcome of peak oxygen consumption (VO_2peak). One study (Yeh et al., 2004) reported that the participants in TCC-group increased the walking distance in 6 minutes (p=0.001), hence, the changes in VO_2peak were not significant (p=0.08). However, TCC-group improved by almost 1mL/kg/min in comparison to the control-group; which presented a deterioration of 0.7 mL/kg/min. In contrast, the other study (Yeh et al., 2008), revealed that TCC-group improved the walking distance in 6 minutes (76 m ± 52) in comparison to the control-group (-33 m±85) (p<0.01). In addition, no significant associations were seen with HFC-VO_2peak and LFC-VO_2peak (p=0.10; p=0.59). Whereas, the latest study (Yeh et al., 2011) demonstrated that these two outcomes, were modest and equal between TCC and control-group; with no significant differences in the meters (p=0.95) and mL/kg/min (p=0.81). The latest study (Leung et al., (2012) revealed that TCC-group, increased significantly (mean difference, 95% CI) the walk time (384 seconds, 186 to 510).

Two studies examined the levels of serum B-type natriuretic peptide (BNP) and neurohormones. It demonstrated a decline in BNP (-138 pg/mL, p=0.03), hence no significant associations were seen with catecholamines and neurohormones (norepinephrine [p=0.46]; epinephrine [p=0.18]; dopamine [p=0.87]; BNP [p=0.62]) (Yeh et al., 2004). In addition, non-significant trends were observed in improvement in serum-BNP with TCC participants in contrast to the usual care-group (p=0.08) (Yeh et al., 2008).

Table 5. Summary of Tai chi chuan effects on exercise capacity

Study	Duration (weeks/months)	Tools	Groups	Outcome (Baseline)	Outcome (End)	P-Value	95% Coefficient Interval Mean difference between groups
Leung et al. (2012)	12 weeks	⚹ ISWT (m) (Peak)	**TCC** **Control**	349±136 402±179	388±135 386±169		**55** (**95% CI 31 to 80**)
Leung et al. (2012)	12 weeks	⚹ ESWT(s) (Endurance)	**TCC** **Control**	467±276 422±334	803±364 430±383		**348** (**95% CI 186 to 510**)
Yeh et al. (2011)	12 weeks	⚹ 6MWT (m)	ˣ**TCC** **Education**	391(265, 475) 392(277, 482)	426(281, 503) 394(326, 510)	(***p*=0.89**)	
Yeh et al. (2004)	12 weeks	⚹6MWT (m)	**TCC** **Control**	327±106 340±117	412±116 289±165	(***p*=0.001**)	
Yeh et al. (2008)	12 weeks	⚹6MWT (m)	**TCC** **Control**	NA NA	76 m ± 52 -33 m ±85	(***p*<0.01**)	

Abbreviations: TCC, Tai Chi Chuan; 6MWT, 6 Mintutes Walk Test; ISWT; Incremental Shuttle Walk Test; ESWT, Endurance Shuttle Walk Test; ⚹increase value=improvement; mm: millimetres; m: meters; s: seconds; ˣ Median (Q1, Q3).

Table 6. Summary of Tai chi chuan effects on balance and strength

Study	Duration (weeks)	Tools	Groups	Anterior-posterior Sway (Baseline to End)		Medial-lateral Sway (Baseline to End)		95% Coefficient Interval Mean difference between groups	
				†Side by Side Stand				Anterior-posterior Sway	Medial-lateral Sway
								-6.3 (95% CI -10 to -2)	**-13.4 (95% CI -20 to-7)**
Leung et al. (2012)	12 weeks	Body Sway Test (mm)	**TCC**	23.2±12	18.4±7	30.3±13	17.6±7		
			Control	21.7±7	23.2±8	25.6±12	26.4±1		
				† Semi-Tandem Stand				Anterior-posterior Sway	Medial-lateral Sway
								-7 (95% CI -14 to 0.4)	**-12.4 (95% CI -21 to -7)**
Leung et al. (2012)	12 weeks	Body Sway Test (mm)	**TCC**	29.0±10	21.8±6	8.6±18	25.8±10		
			Control	24.6±13	28.7±17	29.1±12	32.6±12		
				⁎Balance-outcome					
Leung et al. (2012)	12 weeks	Functional Reach Test (cm)	**TCC**	30.1±8		34.7±7		**5.4 (95% CI 3 to 8)**	
			Control	29.4±8		28.7±8			
				1. ⁎ Isokinetic quadriceps Strength				**Left leg**	**Right leg**
				Left leg		**Right leg**		**17.8 (95% CI 6 to 29)**	**24 (95% CI 14.5 to 33.5)**
Leung et al. (2012)	12 weeks	Kin Com	**TCC**	123±46	139±50	119±51	136±54		
			Control	153±50	151±46	143±50	136±47		

Abbreviations: TCC, Tai chi; mm, millimetres; m, meters; cm, centimetres'; †low value=improvement; ⁎increase value=improvement.

Table 7. Summary of Tai chi chuan effects psychological symptoms and perceived social support

Study	Duration (weeks/months)	Tool	Groups	Outcome (Baseline to End)		P-Value	95% Coefficient Interval Mean difference between groups	
				⚹**Perceived Social Support**		**(*p*=0.04)**		
Chan et al. (2013)	3 months	MSPSS	**TCC**	51.09±18.75	53.94±18.54			
			Control	47.18±17.16	52.30±17.68			
			Exercise	50.54±16.71	51.51±15.02			
				⚹**Perceived Social Support**		**(*p*=0.250)**		
Chan et al. (2010)	3 months	MSPSS	**TCC**	50.3±18.1	52.8±17.5			
			Control	46.6±16.4	51.1±17.4			
			Exercise	50.2±17.1	52.1±14.6			
							Anxiety	**Depression**
				†**Anxiety and Depression**			**-2 (95% CI -2 to -0.5)**	**-2 (95% CI -3 to 0.02)**
Leung et al. (2012)	3 months	HADS	**TCC**	4±3	3±3	4±3	3±3	
			Control	5±4	6±6	3±2	4±4	
				†**Mood State**		**(P=.01)**		
Yeh et al. (2011)	12 weeks	Profile of mood of States	ˣ **TCC**	10(3, 29)	4(-3, 12)			
			Education	18(6,30)	17(4,32)			

Abbreviations: TCC: Tai Chi Chuan; TCQ: Tai Chi Qigong; MSPSS, Multidimensional Scale of Perceived Social Support; HADS, Hospital Anxiety and Depression scale; ⚹increase value=improvement; †low value=improvement; ˣMedian (Q1, Q3).

Table 8. Summary of Tai chi chuan effects on other outcomes

Study	Duration (weeks/months)	Groups	Outcome (Baseline to End)		P-Value
			⚹ **Exercise Self efficacy**		**(*p*<.001)**
Yeh et al. (2011)	12 weeks	ˣ**TCC**	3.6(2.7, 3.8)	3.7(3.5, 4.1)	
		Education	3.7(3.1, 4.3)	3.4(3.0, 4.0)	
			†**Serum Biomarkers (BNP)**		
Yeh et al. (2004)	12 weeks	**TCC**	329±377	281±365	**(*P*=0.03)**
		Control	285±340	375±429	
			*Sleep HFC	¥Sleep LFC	Sleep HFC	Sleep LFC
			Mean change			
					(p=0.04)	**(p<0.01)**
Yeh et al. (2008)	12 weeks	**TCC**	0.05±0.10	-0.09±0.09		
		Control	0.06 ±0.09	+0.13±0.13		

Abbreviations: TCC, Tai Chi Chuan; HFC, High Frequency Coupling; LFC, Lower Frequency Coupling, * Stable sleep state; ¥ Unstable sleep state; ˣ Median (Q1, Q3).

Risk of bias assessment

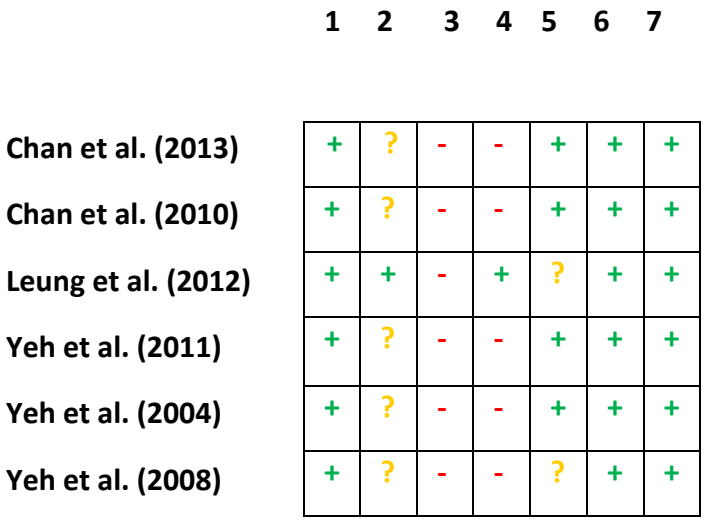

Figure 2. Risk of bias assessment. 1, Random sequence generation (selection bias); 2, Allocation concealment (selection bias); 3 Blinding of participants and personnel (performance bias); 4, Blinding of outcome assessment (detection bias); 5, Incomplete outcome data (attrition bias); 6, Selective reporting (reporting bias); 7, Other bias.

Quality and risk of bias in included studies

The results of the quality assessment are stated in **Appendix 3**. The quality assessment was performed to identify the quality of papers. However, none of the studies were excluded due to low quality. Not all of the trials provided full details of the randomisation process, allocation concealment or blinding of outcome assessment.

The Jadad score ranged between 0 to 3 out of 5. One study scored 0 (Yeh et al., 2008); one study scored 2 (Leung et al., 2012) and four studies scored 3 (Yeh et al., 2004; Chan et al., 2010; Yeh et al., 2011; Chan et al., 2013).These scores indicated low quality; this is due to the fact that the double-blinding criterion is not feasible in these kind of RCT within exercise intervention. On Jadad scale this 40% accounts for the double-blinding criterion (Hempel et al., 2011).

All the included studies were evaluated in terms of its risk of bias (**Figure 2**). Major sources of the risk of bias were related to allocation concealment, blinding study subjects or research personnel and blinding of outcome assessment. Risk of reporting bias was low in general. Despite the difficulties of participants blinding and delivery of intervention, one trial attempted to blind the outcome assessment, in order to minimize the potential methodological bias. Therefore, a high risk of biases might be introduced in most of the RCTs included.

Discussion

When patients are affected by chronic conditions, their QOL becomes increasingly important, as the disease has a long-life impact on physical, psychological and social health status (Li, Yuan & Zhan, 2014).

The studies that were included in this systematic review, evaluated the QOL which was measured via self-administered questionnaires. The majority of the studies indicated TCC had significant improvements in the score of QOL; whereas only one study (Chan et al., 2010) found no significant improvement in the total scores of the questionnaire.

Nonetheless, a study by Yeh et al. (2004) enrolled into the TCC-group patients with NYHA-class IV. These accounted for 13% of the group. Patients with higher NYHA-class, or COPD-stage may show greater improvements which could explain why the authors found stronger effects. In addition, data from the studies demonstrated that TCC improved balance and isokinetic muscle strength, the walking distance and time, sleep, self-efficacy and psychological symptoms and perceived of social support (**Table 6; Table 7; Table 8**). However, according to Beaton et al. (2001), it is important to remember that not all statistically significant differences are also clinically relevant.

Therefore, TCC-intervention did not affect other important clinical outcomes such as: VO_2peak; blood pressure, neuro-hormones and catecholamines. However, it was stated that the individuals who practised TCC, as it was measured by the Community Healthy Activities Model Program for Seniors questionnaire, increased significantly their metabolic expenditure (calories per week spend in moderate intensity activities outside of the study) ($p=.05$) (Yeh et al., 2011). In accordance with these findings, a previous meta-analysis (Pan, Yan, Guo & Yan, 2012), evaluated the therapeutic effects of TCC on patients with HF and reported better scores on MLHF. However, they did not find any improvement in other important clinical outcomes such as: BNP; blood pressure and VO_2peak; something similar to this review.

A more recent systematic review (Li et al., 2014) which included 21 studies, amongst which 8 enrolled patients with HF and COPD. It was reported once again that TCC has a beneficial effect and can improve the QOL of these participants. In addition, a number of published studies on TCC have shown improvements in QOL including other clinical conditions such as musculoskeletal system problems (Fransen, Nairn, Winstanley, Lam & Edmonds, 2007; Lee et al., 2009; Wang et al., 2009) and cancer (Sprod et al., 2012; Campo et al., 2013).

Similar to another review (Li et al., 2014), the participants who enrolled in the RCTs' were elderly (**Table 2**) and the age range may not be able to reveal the beneficial effects of TCC on the wider population. Moreover, the studies which reported the gender of their participants, were predominately males. In addition, the studies of this review, which enrolled COPD patients, used different forms and took place in different places which might practise the martial art differently. Therefore these differences were not suitable for comparison. Li et al. (2014) reported that these differences should be a matter of a concern for health care professionals as it might be essential for the understanding of its effects.

Three studies in this review used the Yang-style (Yeh et al., 2004; Yeh et al., 2008; Yeh et al., 2011). This is in accordance with a statement by a previous systematic review by Liu and Frank (2010). They reported that the Yang-style is the most popular style practised by the older population due to the slow, graceful, and sequential movements from one pose to the next in an upright posture (Liu & Frank, 2010). Therefore, this could lead to a better QOL. Due to the previously mentioned combination, as stated by Pan et al. (2012) the interaction between body and mind may account for these effects.

In contrast, more recently Ng et al. (2014) reported that the Sun-Style is also suitable for older people due to the involvement of less difficult movement, such as less deep-knee bending and single leg standing. Furthermore, the usage of various equipment like the wrist weights that were used in TCC-programme (Leung et al., 2012) must be taken into consideration. This type of equipment is not a standard TCC practice. However it is a feasible method to increase the exercise intensity. As TCC movements exist in numerous forms, the forms used among the COPD patients varied. Therefore, this review cannot provide any recommendations on the appropriate type of TCC movements.

A meta-analysis (Yan, Guo, Yao & Pan, 2013) which included eight RCT's, investigated the effects of TCC in patients with COPD and reported improvements in QOL. There were no adverse events related to TCC-programme and a high adherence attendance. This is similar to the data of another meta-analysis (Pan et al., 2012).

However, in this systematic review the data varied. Two studies reported no adverse events in relation to the programme (Yeh et al., 2004; Yeh et al., 2011). Whereas two studies did not report this information (Yeh et al., 2008; Leung et al., 2012).In addition, two studies reported a high rate of attendance (Yeh et al., 2004; Chan et al., 2010), whereas one reported high attrition (Chan et al., 2013).

Time spent and TCC-practise outside of the study also might influence the results. The majority of the studies reported that participants attended most of the sessions and also self-practised apart from the research; they also specified that they were willing to continue practising. One study (Chan et al., 2010) demonstrated that the perceived social support was insignificant during the first 3-months.

However at the 6-months study it became substantial, which might be due to the self-practise of TCC by the majority of the patients (93%). In contrast, the exercise and control-group did not show any significant changes in the perceived social support during the 6-month period. Regarding this improvement, the improvement in mood and self-efficacy, it could be suggested that this may have been a result of the psychological enhancement which is caused by exercise, and the social interaction of the group interventions. In addition, the studies in which the individuals participated in education sessions and gatherings, might increase their exercise level during this period. These results were in accordance with another review (Li et al., 2014); in which patients benefited from discussion and sharing experiences. However this study enrolled patients with cancer.

Also, some studies did not include equal number of both genders, which may affect the applicability of the results and the effectiveness of TCC to both genders.

Overall, the findings of this review suggest that TCC is beneficial for older adults with chronic diseases and it can improve their QOL. Nonetheless, the studies were unable to specify how TCC is associated with the improvements; and therefore it can be concluded that it remains unclear which aspects of TCC are responsible for these benefits.

Limitations

Jadad et al. (1996) reported that RCT's, in order to have high quality, must score between 3 to 5 points range on the scale. The quality assessment of the papers demonstrated that only four studies reached this score. However, none of the records were excluded based on the score. Therefore, a high risk of bias exists in most studies.

Furthermore, the three studies which enrolled HF-patients, were undertaken by the same author and two other studies used the same sample.

The comprehensive search strategy was performed in order to minimise publication bias. Nevertheless, it may not have been sufficient to prevent bias, as identifying and improving potential biases is not easy (Sterne, Egger & Moher, 2011).

The exclusion of non-English language records may have introduced language bias, and this is another limitation of this review. The search of the records was updated during the process of the review, to prevent any time-lag biases; however it is impossible to exclude such biases. In addition, the review included only six records, most of them with a small sample. Moreover, the analysis of a single reviewer may result in more errors (Edwards et al., 2002), than perhaps a larger group of reviewers.

Conclusion

Despite the limitations in the studies, TCC has been demonstrated to have beneficial effects on the primary outcome of this review: the QOL. However, TCC is not clearly associated with the improvements of the secondary outcomes of this review. This is in accordance with previous systematic reviews, which have observed that this is an evidence gap in terms of understanding the full effects of TCC. However, this systematic review included studies which previous reviews did not include; which were providing new information. The style, time, age and gender of the participants might affect the results. Despite this, the findings of this review suggest that TCC is safe and may improve QOL in patients with HF and COPD. However, more studies ith better methodologies are required to explain how TCC is

affecting the QOL. In light of these that have been reported, the results must be interpreted with caution.

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Appendix 1. Glossary

Boolean operators: are used to combine terms during electronic searches. That includes "AND" (narrow a search), "OR" (broaden a search) and "NOT" (exclude terms from a search) (Centre of reviews and dissemination, 2009).

Cardiac exercise self-efficacy instrument: A 16-item scale evaluating patient's confidence to perform certain exercise on a 5-point scale; score range 16 to 80 with higher scores indicating an increase of the self-efficacy (Yeh et al., 2011).

Confidence interval: a measure of uncertainty around the results of a statistical analysis that defines the range of values within which we can be reasonably sure that the true effect lies. A 95% confidence interval for example is based on the notion that if a study were repeated many times in other samples from the same population, 95% of the confidence intervals from

those studies would include the true value of the effect being measured. Wider intervals indicate lower precision; narrow intervals, greater precision (Centre of reviews and dissemination, 2009).

Control group: acts as a comparator for one or more experimental interventions in a controlled trial study (Centre of reviews and dissemination, 2009).

Chronic obstructive pulmonary disease: is a disease state characterized by airflow limitation; not fully reversible. The limitation is usually progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases (GOLD, 2006).

Chronic respiratory disease questionnaire: Is a disease-specific measurement tool to assess health-related quality of life in patients with COPD. There are 20 questions which are grouped into one of four domains: dyspnoea (5 questions), fatigue (4 questions), emotional function (7 questions), and mastery (4 questions), as well as total score. Each question was scored from one to seven, **with higher scores indicating less impairment in health status.** A change of 0.5 in the mean score per domain (calculated by dividing the overall score by the number of questions) has been shown to be associated with a minimal important difference in health status. This means that a minimal important difference would be 2.5 for dyspnoea, 2 for fatigue, 3.5 for emotional function, 2 for mastery, and 10 for the total questionnaire score (**higher scores indicate improvement**) (Esteban, Quintana, Aburto, Moraza & Capelastegui, 2006).

Endurance shuttle walk test: is a standardized externally controlled constant paced field test for the assessment of endurance capacity in chronic lung disease. The test was developed as an adjunct to the ISWT; then together they form a practical method of evaluating functional and endurance exercise capacity, using a 10 meter shuttle course (Revill, Morgan, Singh, Williams& Hardman, 1999).

Exercise capacity: is the maximum amount of physical exertion that an individual can sustain (Goldstein, 1990).

Heart failure: is a serious clinical syndrome caused by a variety of structural and functional cardiac disorders that result in the ability of the heart to meet the body needs (Hunt et al., 2001).

Incremental shuttle walk test: It is a progressive 10 metre shuttle walking test, which is monitoring the functional capacity of patients with COPD (Singh, Morgan, Scott, Walters, & Hardman 1992).

Minnesota living with heart failure questionnaire: The questionnaire has 21 items. Questions assess the impact of frequent physical symptoms of heart failure, shortness of breath, fatigue, swollen ankles and difficulty sleeping.

Other items ask about the effects of the disease on physical and social functions including walking and climbing stairs, household work, need to rest, working to earn a living, going places away from home, doing things with family or friends, recreational activities, sports or hobbies, sexual activities, eating foods he patient likes and mental and emotional functions of concentration and memory, worry, loss of self-control, and being a burden to others. The response format for each question ranges from zero meaning no effect on the patient's living as he or she wanted, to 5 meaning the item affected the patient's life very much during the past month. The total score for the 21 items can range from 0 to 105. **A lower MLHF score indicates better quality of life** (Garin et al., 2013).

MSPSS: Is a 12-item questionnaire that examines the self-perceived social support from social relationships, including family, friends and significant others. It consists a seven-point scale set from 1 (strongly disagree) to 7 (strongly agree). The total score ranges from 12 to 84, with **higher scores indicating higher levels of perceived support** (Zimet, Dahlem, Zimet & Farley, 1988).

Primary outcome: is the main or the outcome of greatest importance (Centre of reviews and dissemination, 2009).

Profile of mood states: An instrument for assessing emotional states that are transient and expected to respond to clinical intervention. It consists 65 single-word items rated on a 5-point scale to indicate recent mood in 6 dimensions: tension/anxiety, depression/dejection, anger/hostility, vigor/activity, fatigue/inertia, and confusion/bewilderment. **A decreased total mood disturbance score denotes an improved emotional state** (McNair, Lorr & Droppelman, 1992).

Publication bias: studies with statistically significant results are more likely to be published than those with inconclusive results. Bias arising from this fact; is usually often (Centre of reviews and dissemination, 2009).

Qiqong: is considered the ancient root of all traditional Chinese medicine which can combined with Tai Chi Chuan. Qigong exercises consist of a series of orchestrated practices including body posture/movement, practice of breathing, and meditation (Rogers, Larkey & Keller, 2009).

Quality of life: is a term that refers to people's emotional, social and physical wellbeing, and their ability to function in the ordinary tasks of living (Fallowfield, 1990).

Randomized controlled trial (RCT): A RCT allocates participants, or groups of participants, to groups using randomization and concealment (Centre for Reviews and Dissemination, 2009).

Secondary outcome: An outcome which is less important than the primary outcome (Centre for Reviews and Dissemination, 2009).

Selection bias (in this systematic review): bias arising from the way in which studies were selected for inclusion in a systematic review (Centre for Reviews and Dissemination, 2009).

Six minutes' walk test: assess the submaximal level of functional exercise capacity in individuals. It measures the walk distance in a period of 6 minutes (6-minute walking distance/6MWD). The walking course must have a length of 30 meters and should be marked every 3-minutes (Guyatt et al., 1985)

St George's respiratory questionnaire (SGRQ): designed to measure in two parts the health impairment in patients with asthma and COPD. Part I produces the symptoms score, and Part 2 the Activity and Impacts scores. **A Total score is also produced. Score ranges from 0 to 100, where 0 indicates "best health" and 100 indicates "worst health"** (Jones, Quirk, & Baveystock, 1991).

Tai chi chuan: is a mind-body movement therapy with origins in Chinese martial and healing arts (Yeh et. al., 2004).

The hospital anxiety and depression scale: Is a self-administered measure used to screen depression and anxiety. Seven-items are related to anxiety and seven are related to depression. Each item on the questionnaire is scored from 0-3 and this means that a person can score between 0 and 21 for either anxiety or depression (**lower scores indicate better anxiety and depression**) (Zigmond & Snaith, 1983).

Time up and go test: measures in seconds the time taken by an individual to stand up from a standard arm chair walk a distance of 3-meters, turn, walk back to the chair, and sit down (Shumway-Cook, Brauer, & Woollacott, 2000).

Appendix 2. PRISMA checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	**1**		**1**
Structured summary	**2**		**1-5**
Rationale	**3**		**2**
Objectives	**4**		**6**
Protocol and registration	**5**		**NA**
Eligibility criteria	**6**		**8-12**
Information sources	**7**		**XII**
Search	**8**		**NA**
Study selection	**9**		**7-8**
Data collection process	**10**		**4-6**
Data items	**11**		**IX**

NA: Not available Taken from Moher et al. (2009)

PRISMA checklist (Continued)

Section/topic	#	Checklist item	Reported on page #
Risk of bias in individual studies	**12**		**22; XI**
Summary measures	**13**		**15; 18-21**
Synthesis of results	**14**		**NA**
Risk of bias across studies	**15**		**23; 28**
Additional analyses	**16**		**NA**
Study selection	**17**		**7-8**
Study characteristics	**18**		**8-14**
Risk of bias within studies	**19**		**22-23; XI**
Results of individual studies	**20**		**13-21**
Synthesis of results	**21**		**NA**
Risk of bias across studies	**22**		**28**
Additional analysis	**23**		**NA**

NA: Not available

Taken from Moher et al. (2009)

PRISMA checklist (Continued)

Section/topic	#	Checklist item	Reported on page #
DISCUSSION			
Summary of evidence	**24**		**24-29**
Limitations	**25**		**28**
Conclusions	**26**		**24-29**
Funding	**27**		**NA**

NA: Not available

Taken from Moher et al. (2009)

Appendix 3. Methodological quality assessment with Jadad scale

	Potential Score					
JADAD SCORING CRITERIA	**Yeh et al. (2004)**	**Yeh et al. (2008)**	**Chan et al. (2010)**	**Yeh et al. (2011)**	**Leung et al. (2012)**	**Chan et al. (2013)**
1. The study described as randomized?	**1**	**1**	**1**	**1**	**1**	**1**
2. Was the method of randomization described and appropriate to conceal allocation?	**1**	**-1**	**1**	**1**	**1**	**1**
3. Was there a description Of withdrawals and drop outs?	**1**	**0**	**1**	**1**	**0**	**1**
4. Was the study described as Double-blinded?	**0**	**0**	**0**	**0**	**0**	**0**
5. Was the method of blinding inappropriate?	**0**	**0**	**0**	**0**	**0**	**0**
FINAL SCORE (0 – 5)	**3/5**	**0/5**	**3/5**	**3/5**	**2/5**	**3/5**

Appendix 4. Description of the PICOS elements included in the systematic review

Description	PICOS
Studies of participants who were male or female and were classified as patients with heart failure or chronic obstructive pulmonary disease.	Population
Studies that used Tai Chi Chuan as an intervention alone or in combination; where the frequency, intensity, time and type were reported.	Intervention
Studies that compared Tai Chi Chuan with other exercise forms, placebo, non-therapy	Comparison
Any Tai Chuan QOL outcome that observed during and post-Intervention	Outcome
Randomized Control Trials	Study Design

Initial eligibility screening criteria

Description	PICOS
Was the study a Randomized Control Trial?	Study Design
Did the study include patients with Heart Failure or Chronic Obstructive Pulmonary Disease?	Population
Was the intervention Tai Chi Chuan or combined with another type of exercise?	Intervention

Appendix 5. Databases searching and record results

Descriptions of the bibliographical databases

Database	Summary of coverage	Access Method	Dates Searched
PUBMED (MEDLINE)	**Biomedical literature** Comprises more than24 million citations from MEDLINE, life science journals and online books.	PubMed interface	2000-End June 2014
Cumulative Index To Nursing and Allied Health (CINAHL)	**Health and social care** Offers more than375 full-text and Literature and secondary Research databases and over 550.000 e-books plus subscription management services for 360.000 e-journals, e-journals packages and print journals	EBSCO interface	2000-End June 2014
ScienceDirect	**Physical; Life; health and social sciences** is a leading full-text scientific database offering journal articles and book chapters from nearly 2,500 journals and 26,000 books.	ScienceDirect Interface	2000-End June 2014

Number of records from the initial basic search strategy

Search Terms	Number of records retrieved from Science Direct	Number of records retrieved from MEDLINE	Number of records retrieved from CINHAL	
HF AND TCC	26	7	29	
COPD AND TCC	24	8	16	
	50	**15**	**45**	**110**

Appendix 6. Journal and keywords hand searched

Name of Journals	
Archives of Internal Medicine	Complementary Therapies and medicine
Complementary and alternative medicine	Archives of Physical Medicine and Rehabilitation
The Journal of the American Medical Association (JAMA)	

Keywords related to Tai Chi Chuan and Heart Failure and Chronic Obstructive Pulmonary Disease	
Aerobic	Exercise
Aerobic Exercise	Exercise intervention
Aerobic Training	Heart
Cardiac	Pulmonary
Cardiopulmonary	Rehabilitation
Cardiorespiratory	Respiratory
Chi Kung	Taiji
Chinese	Qigong
Disease	Quality of life

Appendix 7. Yang-style Tai Chi Chuan programme

Week	Activities	Approximate Duration (min)
1	Introductory Session: Overview of Program	
	1. Tai chi principles, philosophies	15
	2. Demonstration of tai chi form	10
	3. Expectations of participants	10
	4. Description of class format	5
	5. Participation in warm-up exercises	30
2–5	Warm-up Exercises (Repeated during All Sessions)	
	1. Standing	
	a) "Drumming the body"	6
	b) "Swinging to connect kidney and lungs"	3
	c) "Washing the body with qi"	3
	d) Standing meditation and breathing	3
	2. Sitting	
	a) Neck/shoulder stretches	6
	b) Arm/leg stretches	3
	c) Sitting meditation and breathing	6
	Total Warm-up time	**30**
	Tai Chi Movements	
	1. "Raising the power"	5–10
	2. "Withdraw and push" 5 per side	
	(Warm-up and Movements 1–2)	
	3. "Grasp sparrow's tail" 5 per side	
	4. "Brush knee twist step" 5 per side	
10–12	(Warm-up and Movements 1–4)	
	5. "Wave hands like clouds"	5–10

Appendix 8. Studies included in the review

No. of study	Name of study	Authors	Year
1	Effects of tai chi mind-body movement therapy on functional status and exercise capacity in patients with chronic heart failure: a randomized controlled trial	Yeh et al.	2004
2	Enhancement of sleep stability with tai chi exercise in chronic heart failure: preliminary findings using an ECG-based spectrogram method	Yeh et al.	2008
3	Effectiveness of a tai chi qigong program in promoting health-related quality of life and perceived social support In chronic obstructive pulmonary disease clients	Chan et al.	2010
4	Tai chi exercise in patients with chronic heart failure: a randomized control trial	Yeh et al.	2011
5	Short-form sun-style tai chi as an exercise training modality in people with COPD	Lueng et al.	2012
6	Evaluation of the sustaining effects of tai chi Qigong in the sixth month in promoting Psychosocial health in COPD patients: A single-blind, randomized controlled trial	Chan et al.	2013

Appendix 9. Pilot studies excluded from the review

No. of study	Name of Pilot study	Authors	Year
1	Tai chi exercise in patients with chronic heart Failure.	Yeh, Wayne and Philips	2008
2	Tai chi for patients with chronic obstructive pulmonary disease: a pilot study.	Yeh et al.	2010
3	Tai chi enhances the effects of endurance training in the rehabilitation of elderly patients with chronic heart failure.	Caminiti et al.	2011
4	Tai chi in patients with heart failure with preserved ejection fraction.	Yeh et al.	2013
5	Effectiveness of incorporating tai chi in a pulmonary rehabilitation program for chronic obstructive pulmonary disease in primary care-a pilot randomized controlled trial.	Ng et al.	2014

Appendix 9. Studies excluded from the review (Continued)

No. of study	Name of study reported psychological outcome	Authors	Year
Pilot study			
1	An evaluation of the effects of tai chi chuan and chi kung training in patients with symptomatic heart failure: a randomized controlled pilot study.	Barrow et al.	2007
Pilot study			
2	A pilot study exploring the effects of a 12-week tai chi intervention on somatic symptoms of depression in patients with heart failure.	Redwine et al.	2012
No. of study	**Name of study reported age-related outcome**	**Authors**	**Year**
Pilot study			
3	A systems biology approach to studying tai chi, Physiological complexity and healthy aging: design and rationale of a pragmatic randomized controlled trial.	Wayne et al.	2013